neath the trestle. The bins were within reach of a derrick placed on the platform of the mixer. When a batch of concrete was to be made, hand-cars containing buckets were run under the proper bins, and loaded by gravity with the requisite quantity of stone and sand. The buckets were then transferred to the mixing platform by means of the derrick, where the cement was added. The mixer was composed of three hoppers, each having a movable gate or trap in the bottom. In the first or top hopper the sand and stone were combined with the cement, and allowed to fall by gravity into the second hopper, where water was added, then into the third directly beneath it, where the process of composition was completed. From this the material fell into ladles mounted on cars, whence it was hauled by animal power to the vicinity of the mold. Here the loaded ladle was lifted by a derrick, its contents transferred to the mold, then replaced on the car to be again filled at the mixer. The derricks of the ordinary boom type, operated by steam hoisting engines, were set at convenient points on the station site. The tramways used were composed of rails weighing but 15 pounds to a section. Consequently, they could be quickly and easily laid by a half dozen men as fast as needed for moving the material.

At the beginning of the work, iron rods were used in connection with the concrete to give it more strength and tenacity, but wire was finally substituted for reinforcing the material. The sizes set into the material ranged from ¼ to 7/16 of an inch in thickness, depending upon the nature of the work. In setting the wires in the molds, they were placed at an average distance of three inches apart, the outer sections being laid at right angles to each other. As the photographs show, the molds for the walls as well as the interior columns and piers were constructed of wooden framework in the usual manner. Where possible this was built in sections, so that when the concrete had solidified, the false work could be pulled off by means of a derrick, saving the time and expense of knocking it apart. One reason for the rapidity with which the foundations have been built, is the short time required for the concrete to solidify. In the spring and summer months it would set in a maximum period of 36 hours from the time material was poured into the molds in a semi-liquid state. The time in winter is somewhat longer, depending of course upon the temperature.

THE MODERN HIGH-SPEED LOCOMOTIVE.

The great increase that has taken place of late years in the size, weight, and power of fast passenger locomotives, is to be ascribed mainly to two causes. First, the increased weight of the trains, and second, the demand on the behalf of the public for faster trains. Of these two causes, the former has been the most active in influencing the design of the locomotive; for while there has been a decided increase in the speed of express trains, there has been a relatively greater increase in their weight, some of the trains being of a weight which, a few years ago, would have been considered prohibitive.

Contemporaneously with the increase in weight and power of express locomotives, there has taken place a decided change in type. Not many years ago the term "American locomotive," as applied to those that hauled passenger trains, was universally understood to mean an eight-wheel engine with a forward truck, four coupled wheels, and the cylinder driving the leading axle. The call for greater power and a larger boiler then led to the introduction of a third pair of driving wheels, giving us the six-coupled express engine which, for a while, held undisputed possession of the field for heavy fast passenger trains. This, in turn, was succeeded by the celebrated Atlantic type, a ten-wheeled engine with a forward truck, four coupled driving wheels, and a pair of trailing wheels beneath the firebox, the cylinder being connected to the rear driving wheels—a type that is in such wide use to-day that it may be considered the typical American locomotive of the opening years of the twentieth century. It has proved in every respect a most successful type, and some of the heaviest, fastest, and most famous trains in America are hauled exclusively by Atlantic engines. The credit for the introduction of this type belongs largely to the Baldwin Company, and the first engines turned out by them sprang into immediate favor and prominence by the great work they accomplished in hauling the fast summer expresses between Philadelphia and Atlantic City.

The remarkable photograph shown on the front page of this issue represents the most powerful express engine of this type in existence. It was built for the Chicago & Alton Railway, for hauling their fast passenger trains between Chicago and St. Louis during the World's Fair. It is one of several that were ordered, and it formed part of the exhibit of the builders in the Transportation Building at St. Louis. Perhaps the best known of the large Atlantic engines are those which were built by the American Locomotive Company for handling the fast passenger traffic on the New York Central Railroad, and the great power of this Chicago & Alton engine can be understood by comparing its cylinder dimensions with those of the New York Central engine, which are 21½ inches in diameter by 26 inches stroke. The Chicago engine has cylinders of 22 inches diameter and 28 inches stroke, and as the steam pressure, heating surface, and diameter of driving wheel are the same, the engine is, of course, more powerful than the New York Central engines, the tractive force or drawbar pull being 28,798 pounds. The weight on the drivers is 145,000 pounds, the weight of the engine in working order is 221,300 pounds, and the weight of the tender 166,000 pounds. The barrel of the boiler is 70 inches in diameter, and it contains 276 tubes, 2¼ inches in diameter and 20 feet long, whose aggregate heating surface is 3,234 square feet. The firebox contains 202 square feet of heating surface, giving a total heating surface of 3,436 square feet. The driving wheels are 80 inches in diameter.

The engine shown on our front page was engaged in hauling, during last summer, what are known on the Chicago & Alton road as trains No. 2 and No. 11. Train No. 2, running from St. Louis to Chicago, consisted of eight cars which, with baggage and passengers, weighed 475 tons. Five stops were made, the average duration of stops being four minutes, and the average speed of the train was 40 miles an hour including these stops. The weight of train No. 11, running from Chicago to St. Louis, varied from day to day, but frequently no less than fifteen cars were coupled on behind the big engine, in which case the weight of the train, passengers, and baggage exceeded 800 tons. This train was scheduled to make the same speed, and it had to do this in spite of four stops, the average duration of which was 4½ minutes.

When we read of 80-inch driving wheels, 22-inch cylinders, and 70-inch boilers, the average reader receives no adequate impression of the resulting size of the locomotive. In the present case, the photographer selected a point of view that gives one a most impressive sense of the huge bulk and impressive dignity of this splendid engine.

THE GREAT 3,000-MILE YACHT RACE.

The hearts of the deep-sea yachtsmen must have been gladdened on the afternoon of May 16, when they saw that noble fleet of nigh upon a dozen ocean-going yachts sweep over the starting line at the historic Sandy Hook lightship. Of late years, with every recurring international race, we have been accustomed to hear many an expression of regret that the influence of the America Cup contests on yacht design and construction should have resulted in the development of a yacht that was a racing machine pure and simple, costly to build, costly to operate, and practically worthless when the three brief races for the cup had been sailed. There is a large body of yachtsmen, including most of the older men and not a few of the younger and most progressive, that has been endeavoring to control the development of the mere racing machine, and bring back the design and construction of yachts to more reasonable models and more wholesome and less costly materials. There are two effective ways in which this may be accomplished. One is by framing rules of measurement which will give a yacht of wholesome model such a decided advantage in time allowance over yachts of the "freak" type that the motive for building these extreme "measurement cheaters," as they are called, will disappear, and yacht building will be brought back to normal conditions. Another sure way to eliminate the flimsy and freakish yacht is to encourage deep-sea or ocean racing; for it is a fact that the very extremes of form and dimensions which render a yacht fast in the more or less sheltered waters on which the majority of yachting courses are laid, produce a yacht that is entirely unsuited for the severe conditions that may be met on outside courses. Proof of this was shown during the last America cup races, when the "Shamrock" and "Reliance" were afraid to venture outside Sandy Hook one morning in weather that would have delighted the heart of a yachting skipper in the days of the good old ocean schooners "Henrietta," "Fleetwing," and "Dauntless."

The great ocean race which is now under way across the Atlantic will do much to assist in producing racing yachts of a stancher and more seaworthy type, and we may look for a revival of interest in the genuine ocean-going cruiser. This, in its turn, will improve the type of racing yacht that follows the regattas of the summer season; for owners will naturally wish to have a boat that is capable of winning cups, whether the race be over a triangular course of thirty miles off Sandy Hook or a race for the Kaiser's cup for 3,000 miles across the broad Atlantic Ocean.

As to which yacht is likely to win this race, it is altogether idle to speculate. For the past few weeks, and at the present writing, prognostications as to the outcome have been and are very plentiful. The absolute uncertainty as to the winner undoubtedly lends to ocean yacht racing much of the charm that attaches to it. There are so many variable conditions affecting the result. In the first place, there is the wide variety among the yachts themselves; for they range in size from the little 86½-foot schooner "Fleur-de-Lys" up to the great, full-rigged ship "Valhalla," which measures 240 feet on the waterline. They vary in age from Lord Brassey's world-renowned yacht "Sunbeam," now thirty-four years old, to the up-to-date fore-and-aft schooner "Atlantic," built as late as the year 1903. They vary in construction also from the heavy scantling of the "Valhalla," the "Apache," and the "Sunbeam" to the light construction of the out-and-out racing craft, as represented by the German fore-and-aft schooner "Hamburg" and the even more lightly constructed racing yawl "Ailsa." Some of the craft are sailing vessels pure and simple, such as "Fleur-de-Lys," "Thistle," "Ailsa," "Hildegarde," "Endymion," and "Hamburg." Others, such as "Sunbeam," "Valhalla," "Apache," "Utowana," and "Atlantic," are auxiliaries; that is to say, they carry engines and boilers of sufficient power to drive them at a speed of from 8 to 10 knots under steam alone. The auxiliaries, which have unshipped their propellers, are handicapped as compared with the other yachts by the fact that they must carry from 30 to 70 tons of dead weight in the way of engines, boilers, condensers, shafting, etc., which is not as favorably placed for stability as the same amount of weight when carried in the form of lead in the keels of such vessels as "Hamburg" and "Ailsa."

The greatest element of uncertainty is, of course, the weather, and this for the reason that each yacht, or rather each type of yacht, has its own best weather conditions for speed, and a wind that favors one may be disadvantageous for another. It is probable that the yachts will become considerably scattered. Some will take the more northerly and shorter course, disregarding the warnings of the government to the effect that a large amount of ice will be encountered on this course. They will judge that it is better to accept the interruptions, change of course, etc., that will be necessitated in sailing through an ice field, where the ice is closely strewn, and get through the difficult and dangerous belt as quickly as possible; while others again, among whom is Lord Brassey, who will navigate his own ship, will prefer to take a more southerly course, where there will be no fear of being hindered by having to dodge ice floes and bergs. Those who take the northerly course, and have the good luck to avoid collision and escape delay in passing through the ice, will reap a great advantage in being able to sail a course laid on or approximately on a great circle, and, therefore, considerably shorter than a course laid more to the southward. It is this wide scattering of the yachts that brings in one of the greatest elements of uncertainty; for not only will the distance of the course vary, but the weather conditions also may be widely different. Thus a vessel may be so favored with wind and weather to her liking that she may show up at the Lizard ahead of faster competitors, which sailing under their own most favorable conditions could have easily outdistanced her.

Each skipper, of course, is praying that he may have the particular winds and weather that suit his craft. The big "Valhalla" would like nothing better than to have from half to three-quarters of a gale of wind three points aft of the beam for the whole distance; for under these conditions she could reel off 15 knots with ease. The Earl of Crawford informed the writer that on one occasion he sailed the "Valhalla" from Cape St. Vincent to Gibraltar, a distance of 190 knots, at an average speed of 16.8 knots an hour, the maximum possible tide with or against the yacht being 5-10 of a knot an hour. Under such conditions she could drop the fleet easily. But the probability of a continuous wind of, say, 40 to 45 miles an hour for the course is very remote. With head winds she would be easily left by the fore-and-aft-rigged vessels. Lord Brassey informs us that he has logged 300 miles a day in the "Sunbeam." The fore-and-aft schooners like "Thistle," "Hildegarde," "Endymion," "Hamburg," and

THE INTERNATIONAL OCEAN RACE FOR THE KAISER'S CUP.

Yacht.	Rig.	Where built.	Yacht Club.	Length in feet.	Beam in feet.	Draft in feet.	Owner.
Sunbeam.	Auxiliary Schooner.	England.	Royal Yacht Squadron.	154.7	27.6	13.9	Lord Brassey.
Ailsa.	Yawl.	England.	New York Yacht Club.	89.0	25.5	16.6	Henry S. Redmond.
Thistle.	Schooner.	America.	Atlantic Yacht Club.	110.6	27 8	14.0	Robert E. Tod.
Fleur-de-Lys.	Schooner.	America.	New York Yacht Club.	86.5	21.9	13.0	Lewis A. Stimson.
Valhalla.	Auxiliary Ship.	England.	Royal Yacht Squadron.	240.0	37.2	20.0	Earl of Crawford.
Apache.	Auxiliary Bark.	England.	New York Yacht Club.	178.0	28.0	16.6	Edmund Randolph.
Utowana.	Auxiliary Schooner.	America.	New York Yacht Club.	155.0	27.8	14.6	Allison V. Armour.
Atlantic.	Auxiliary Schooner.	America.	New York Yacht Club.	135.0	29.0	16.5	Wilson Marshall.
Hildegarde.	Schooner.	America.	New York Yacht Club.	103.4	26.0	16.9	Edward R. Coleman.
Endymion.	Auxiliary Schooner.	America.	New York Yacht Club.	101 0	24 4	14.0	George Lauder.
Hamburg.	Schooner.	England.	Kaiserlicher Yacht Club.	116.0	23.9	15.0	German Syndicate.

"Atlantic," would like nothing better than to have a whole-sail reaching breeze from start to finish; a breeze with less weight in it than the "Valhalla," "Utowana," "Sunbeam," and "Apache" would call for. Probably under these conditions the race would lie (that is, if the yachts kept the same course) between the German entry "Hamburg" and Wilson Marshall's "Atlantic," with the odds in favor of the "Hamburg," because of her deep lead and greater stability and her ability to carry canvas longer than the auxiliary yacht, although this would be compensated in great measure by the extra sailing length of the big three-masted schooner. Moreover, Capt. Barr, the most successful racing skipper of the day, is familiar with the ocean passage, and the "Atlantic" will be perfectly sailed and handled.

There is one vessel in the race which is notable for the fact that she is the only yacht built as an out-and-out racing craft that is carrying her full racing canvas into the race. We refer to the handsome yawl "Ailsa," built originally as a cutter to defeat that famous yacht of the nineties, "Britannia." "Ailsa's" chance will come if conditions prevail throughout the course similar to those which are ordinarily met with in the regattas of our summer season. If she is favored with light breezes, in which she can use her big spread of canvas to its best advantage, breezes in which the subtle question of ratio of sail area to wetted surface becomes all important, and especially if light head winds should prevail, Grenville Kane and Capt. Miller will be well repaid for the risk they have taken in stepping the big racing mast for this ocean race. Given her weather, "Ailsa" will prove to be a keen competitor for the cup.

The German yacht "Hamburg" is, like the "Ailsa," a strictly racing craft; but her rig has been greatly reduced—a wise precaution, if the winds should be strong and the seas heavy; but likely to spoil her chances if the winds are light.

The big schooner "Atlantic" is generally picked as the winner, and the expectation is based upon her fine performance last season and upon the fact that Capt. Barr, of America Cup fame, is to be her skipper. Given weather in which she can carry her heavy rig, she should win. In heavy weather she will lose to "Hamburg" or to the square-riggers; in light weather and easterly winds, we look for "Ailsa" to prove her most dangerous competitor.

Mont Pelé's New Dome.

BY EDMUND OTIS HOVEY.

The Abbé Yvon climbed two-thirds of the way to the top of the new "dome" of Mont Pelé in the fall of 1904, and the expedition is thus described by him in La Martinique: The party which started for the mountain consisted of himself, the Abbé Altéroche of Morne Vert, M. Roux, gendarme at Le Carbet, and two porters. Leaving Le Carbet by canoe at 5 o'clock in the morning, they arrived at the mouth of the Rivière Blanche at 6:30, and disembarked. The dry bed of the river is now a gorge with walls averaging 15 meters high. Twice they found the gorge blocked by great rocks which formed cliffs 8 to 10 meters high. The first of these was encountered at twenty minutes' walk from the sea, and the second at one hour and a half. Fumaroles were observed at intervals along the river bed from the second kilometer to the foot of the talus of the new cone.

The slope of the material filling the gorge of the Blanche becomes noticeably steeper at an altitude of about 500 meters above the sea. At this point the party stopped, had breakfast, and rested from the fatigues of the rough journey along the new gorge of the Blanche. When the question arose as to the continuance of the ascent, Abbé Altéroche declared himself too weary to go on. In the words of Abbé Yvon:

"M. Roux and Julien, the servant at Morne Vert, consented to follow me, and we directed our steps toward the middle of the base of the talus slope. My project was in general to climb to the level area on top of the 'dome' at the same altitude as the base of the needle which rises on the side toward Morne Lacroix. I was persuaded that the dome ought to be cold and that the fumaroles there, i. e., on the side toward St. Pierre, ought not to have a very high temperature. Furthermore, since the dome fills the crater of 1902 to 100 meters depth, who knows whether or not a new crater, an avenue of communication with the interior of the earth, does not exist in the summit at the place where, as viewed from Morne Vert, there seems to be a level area? Curiosity impelled me to determine the question if possible, and I resolved to climb clear to the top. The volcano was very tranquil and the vapors seemed less abundant than for days before."

After climbing for a few minutes farther, M. Roux decided to go no higher, but he agreed to await the return of Abbé Yvon and Julien; apparently this decision was reached in the breach of the old crater wall and near the base of the new dome. Beyond this point the first fifty meters were rendered difficult to traverse by the loose stones scattered thickly over the slope, which rolled under foot. Then the Abbé reached the white bands which are a prominent feature of the dome as seen from the sea, which he found to be steep slopes* covered with fine white ash. These had been the path of countless dust-flows for two years. Scrambling across the zone of white bands, the two men reached the solid lava of the dome and were able to climb more easily. Noting a large fumarole to the south of their path, they started toward it. This divergence probably saved their lives, since they had scarcely turned aside before an explosion occurred in the upper part of the dome and in a few seconds an avalanche of great rocks traversed the route up which they had been climbing, scattering fragments even to their feet. M. Roux had barely time to take shelter behind a great rock, before the descending stones reached his level. The avalanche lasted about two minutes and impelled M. Roux to start down the mountain at full speed, as soon as it had ceased. The Abbé was determined to go on by a different route, but Julien was thoroughly frightened and would proceed no farther, so that the Abbé was forced to abandon the ascent when about two-thirds of the way up the dome. He was probably at an elevation of about 1,400 meters.

Before beginning the return journey, the large fumarole was visited and was found to be a crevice two or three centimeters wide and 20 to 25 meters long, beside a high, narrow, serrated ridge, resembling the dorsal fin of a fish placed radially with reference to the dome.

Steam was rising vigorously from the fissure to a height of about three meters above the opening. Much sulphur was observed on the farther side of the crack, but the thickness of the deposit was not determined, because it did not seem prudent to cross the fumarole to measure it. On the return journey across the plateau between the Blanche and Sèche rivers and down the gorge of the latter stream, small fumaroles were seen here and there until within half a kilometer of the sea. These were discharging hot air, but no live steam, under some pressure and with considerable noise.

It may be remarked that although the Abbé found the portion of the dome that he ascended essentially cold, he would probably have found a different condition of affairs prevailing on the summit plateau which he was striving to attain, since the December bulletins of the French volcano commission on Martinique report continued explosions from near the top of the mountain and the frequent appearance of incandescent spots near the summit of the dome.

*These slopes were inclined at an angle of 40 deg., as measured in March, 1903.—E.O.H.

An Inside-Connected Locomotive for Purdue University.

Purdue University is to receive from the New York, New Haven and Hartford Railroad the historic locomotive "Daniel Nason." A few years ago the university interested itself in securing from railways samples of such classes of locomotives as are now being superseded, its purpose being to preserve as museum exhibits types of design which were becoming extinct, and a number of valuable relics are already upon its grounds. From the beginning of this movement an effort has been made to secure a representative of a type which was common throughout New England thirty years ago, namely, an eight-wheeled engine having cylinders inside the frames connecting with the crank axle. This effort has now been crowned with success. The "Daniel Nason" is said to have been built in 1858. It was exhibited in Chicago in 1893 and has since been held as a relic at Roxbury, Mass. The engine weighs about 25 tons, is complete with its tender, and will be shipped to the university at Lafayette, Ind., upon its own wheels.

The university is also to become the custodian, in behalf of the same railway, of a stage-coach passenger car which is said to have been placed in service in 1835. It consists of the body of a stage coach suspended over a simple railway truck by means of thorough braces. It will seat inside and on its top about twenty persons.—American Machinist.

The Current Supplement.

The English correspondent of the SCIENTIFIC AMERICAN opens the current SUPPLEMENT, No. 1533, with an illustrated article on the hydraulic power works on the River Glommen, Norway. Some striking illustrations accompany the text. George W. Dickie's paper on "The Man and the Ship" is concluded. A. Frederick Collins describes the Massie wireless telegraphy system at length. Other articles that deserve to be mentioned are those entitled "Decorative Insulating Beads for Electric Light Wires," "Photographic Chemistry," "The Cement Industry," "A New Form of Friction Clutch," "Salt Furnace for Steel Hardening," "Radium Testing," and the "Present Status of Electric Furnace Working." Karl F. Kellerman discusses copper as an algicide and a disinfectant in water supply.

On the railways of the United Kingdom there is one locomotive and thirty-six vehicles per mile of line. In the United States there is only one per four miles of railway, and thirty-six vehicles per mile.

Correspondence.

Why the Stone Ball Moves.

To the Editor of the SCIENTIFIC AMERICAN:

The movement of the stone ball may be the result of earth vibration, caused by trains on some railway within a radius of five miles. C. BARTHOLOMEW.

East Toronto, May 8, 1905.

Another Solution of the Stone Ball Puzzle.

To the Editor of the SCIENTIFIC AMERICAN:

The photograph and article about the stone ball that is slowly moving around interested me very much. I was sure that you would have a good many letters on the subject, but I do not read in any one of them a suggestion that the moving might be due to some metal embedded in the stone, which is being drawn toward the pole as the needle of a compass is naturally drawn. I do not know if the ball is moving in the right direction for this suggestion to be admissible; but might it not be as near the mark as some of the other ones?

I hope that some time we may hear the correct solution of the subject. N. L. LADD.

East Orange, N. J.

That Stone Ball.

To the Editor of the SCIENTIFIC AMERICAN:

The spontaneous moving stone ball is a very simple problem, if my theory be right. I am willing to leave the matter to you as to whether it is worth mention or not. It is my opinion, based on the theory that the sphere is unbalanced, not due to imperfection in its shape or symmetry, but to density; in other words, one side is heavier than the other. Then the effect of the expansion and contraction of the base or pedestal upon which the ball rests must be considered. The base has a flat surface directly facing the south, and must of course be affected by the sun's rays, producing the creeping motion of the ball. When the heavy part of the ball has reached the bottom, in my opinion it will cease to move. If it continues to move more than half a revolution, then my theory is wrong. It will take time to settle the matter.

New Paris, Ohio, May 4, 1905. DR. C. M. WILCOX.

Sentiment Versus Commercialism.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to an article entitled "Sentiment Versus Sense" in the SCIENTIFIC AMERICAN for May 6, I would like to ask why utilitarian John Pratt does not use the right word? It is not a question of sense, but of dollars and cents. The people who are alive to the beauties of nature, to whom Niagara is not "a great mass of dead matter tumbling in meaningless froth and noise," do not object to a sane withdrawal of water for the production of power.

When, however, the falls are put in danger of ultimate extinction, it will be found that the people of New York State and of the whole country will not be ready to enter upon the "grand and beneficent purpose" of fattening one more corporation. Are the projectors willing to pay for the water? No; if the State offered to sell power for what it is worth, we would not be troubled with these business philanthropists, who would incidentally line their pockets with the millions of dollars which would result from the sale of this power. Nothing that can be put on a good paying basis is safe from the greed of some men. There are other and better standards of value in life than that of money, and we would do well to recognize them.

But whether power is sold or given away, Niagara must not be lost to the millions of people who find delight in it, for the sake of enriching a few capitalists.

H. L. JACKSON,
A citizen of New York State.

Boston, Mass, May 7, 1905.

Output of Baltimore Locomotive Works in 1904.

The total output of the Baldwin Locomotive Works for 1904 was 1,453 locomotives, of which 1,352 were steam, 94 electric and 7 compressed-air. This is nearly one-third less than the number built in 1903, which was 2,022. The falling off in business, which began in the autumn of 1903, affected the locomotive industry. The works were run at their full capacity until last spring, but from June until the latter part of October very few orders were received. During the year 286 locomotives were exported to the following countries: Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Guatemala, Hawaii, Japan, Korea, Mexico, New Zealand, Peru, Porto Rico and South Africa.—The Railroad Gazette.

A new and ingenious pocket calculator, automatic in its action, has been designed by a German inventor. The device comprises a small case about six inches in length made of steel and aluminium. There is a keyboard of nine figures corresponding to the numerals, and it is additionally provided with a small spring for the supply of the tens and hundreds. There is also a small dial, and by pressing the requisite keys the total amount is recorded upon the dial.